

CLAIMS

1. A fuel cell system, comprising:

a fuel cell including a polymer electrolyte membrane-electrode catalyst complex composed of a polymer electrolyte membrane sandwiched between a fuel electrode and an oxidant electrode, and a separator formed with channels through which a fuel and an oxidant are supplied to the polymer electrolyte membrane-electrode catalyst complex; and

an external electric source operative to apply current to the fuel cell and to change a direction in which the current is applied to the fuel cell.

2. The fuel cell system according to claim 1, further comprising:

a controller controlling the external electric source to flow forward current in a direction from the fuel electrode to the oxidant electrode of the fuel cell as well as controlling a first valve to supply a fuel to the oxidant electrode of the fuel cell, thereafter, reversing the direction of the forward current, during a performance of the fuel cell is recovered.

3. The fuel cell system according to claim 2, wherein

the controller controls a value of the reversed current to become greater than that of the forward current.

4. The fuel cell system according to claim 2, further comprising:

fuel-amount detection means detecting an amount of the fuel present on the oxidant electrode of the fuel cell, wherein

the controller controls the external electric source to reverse the direction of the forward current when the amount of the fuel present on the oxidant electrode of the fuel cell exceeds a first given value.

5. The fuel cell system according to claim 4, wherein

the controller controls the external electric source to stop applying the reversed current to the fuel cell when the amount of the fuel present on the oxidant electrode of the fuel cell drops below a second given value less than the first given value.

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6. The fuel cell system according to claim 4, wherein

the fuel-amount detection means includes a sensor mounted on at least one of an inlet and outlet of the oxidant electrode of the fuel cell to detect at least one of hydrogen and pressure present in the oxidant electrode.

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7. The fuel cell system according to claim 3, further comprising:

water-amount detection means detecting an amount of water on a reacting surface of the oxidant electrode.

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8. The fuel cell system according to claim 7, wherein

the water-amount detection means detects an amount of water on the reacting surface of the oxidant electrode depending on at least one of a voltage value and a resistance value of the fuel cell.

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9. The fuel cell system according to claim 3, further comprising:

a second valve disposed in at least one of an inlet and outlet of the oxidant electrode of the fuel cell to shut off at least one of the oxidant to be supplied to the oxidant electrode of the fuel cell and the oxidant to be exhausted from the oxidant electrode of the fuel cell.

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10. The fuel cell system according to claim 7, wherein

an amount of the fuel to be supplied to the oxidant electrode of the fuel cell is determined depending on the amount of water in the oxidant electrode detected by the water-amount detection means.

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11. The fuel cell system according to claim 1, further comprising:

a vessel disposed in an outlet of the oxidant electrode of the fuel cell to store the fuel.

5 12. A method of operating a fuel cell system comprising a fuel cell that includes a polymer electrolyte membrane-electrode catalyst complex composed of a polymer electrolyte membrane sandwiched between a fuel electrode and an oxidant electrode, and an external electric source operative to apply current to the fuel cell, when a performance of the fuel cell is recovered, comprising:

10 supplying fuel to the oxidant electrode of the fuel cell;

activating the external electric source to cause current to flow in a direction from the fuel electrode to the oxidant electrode of the fuel cell; and

switching the external electric source to cause the current to flow in a direction from the oxidant electrode to the fuel electrode.